Characterization and Leucomalachite Green Biodegradation Potential of *Sphingobium* sp. isolated from *Litopenaeus vannamei*

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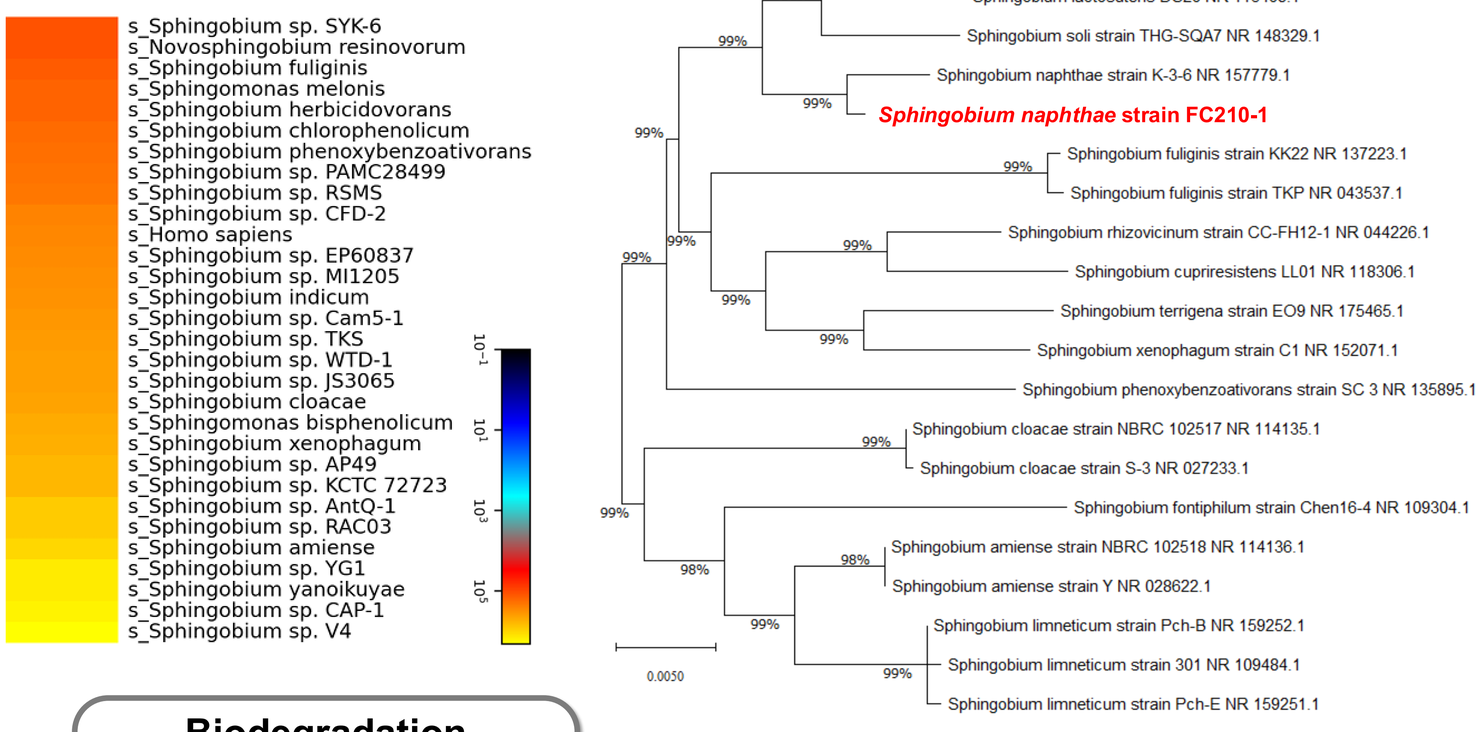
Penaeus vannamei — *Sphingobium* spp.

- **Strain Identification** — 16S rRNA sequencing
- **Characterization** — Growth conditions
- **Biodegradation** — LMG: 1 ppm, 0.5 ppm
- **Biosafety Evaluation** — *Oreochromis niloticus*

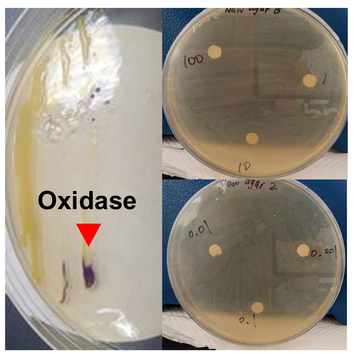
Introduction

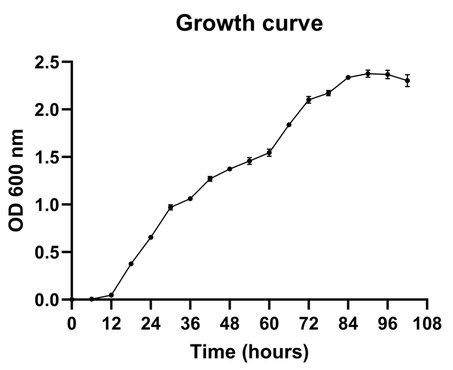
Malachite green (MG) and its primary metabolite, leuco-malachite green (LMG), are toxic triphenylmethane dyes that remain widely used in aquaculture despite regulatory prohibitions. Given the well-documented biodegradative potential of the genus *Sphingobium*, this study explores the feasibility of microbial LMG degradation and assesses its biosafety in Nile tilapia (*Oreochromis niloticus*) to evaluate its suitability as a bioremediation strategy in aquaculture.

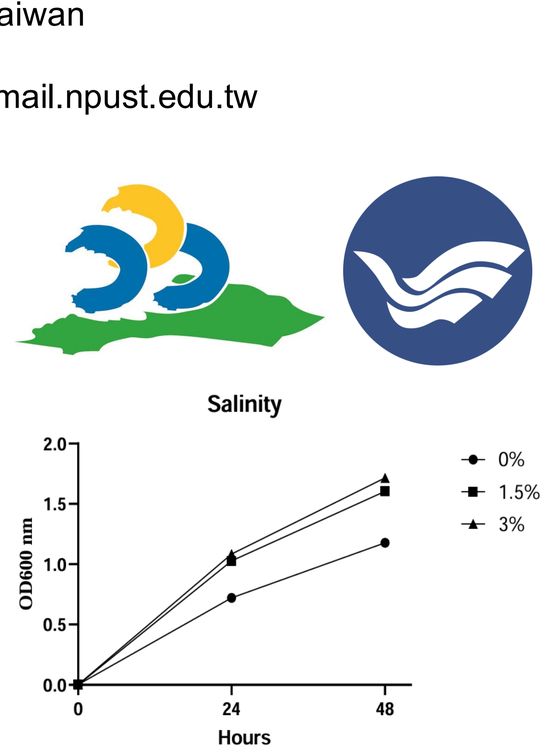
Strain Identification



Characterization







Biodegradation

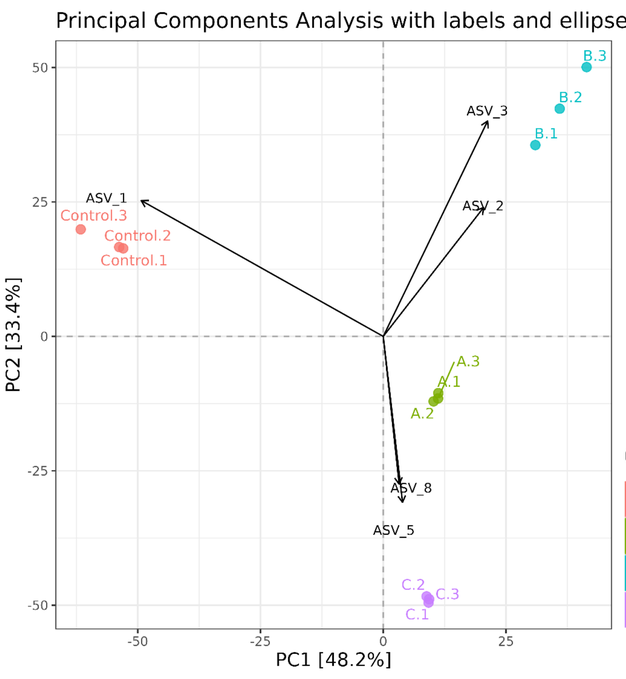
	MG (ppb) (AVG)	Coefficient of variation (CV)	LMG (ppb) (AVG)	Coefficient of variation (CV)	MG+LMG (ppb)	Degradation Rate (%)
LMG 1ppm (1 month)	150.73	1.88	233.6	6.51	384.33	**61.56**
LMG 1ppm (2 month)	66.30	5.23	384	1.04	450.3	**54.97**
LMG 0.5ppm (2 month)	30.97	4.2	142	4.28	172.97	**65.4**

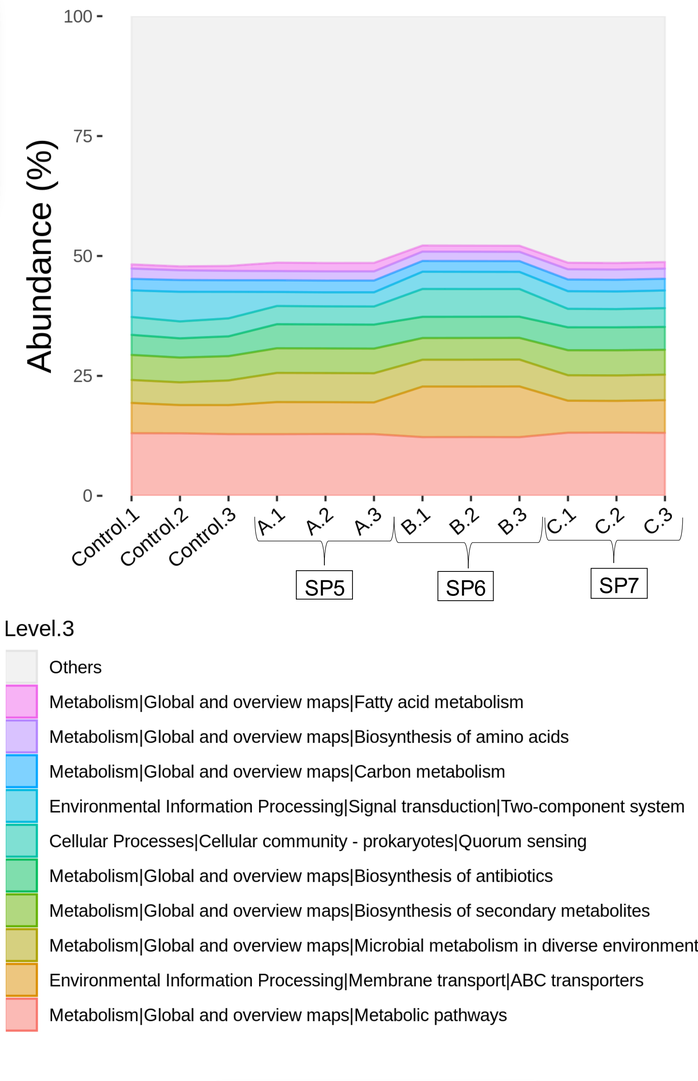
MDL: Method detection limit = 0.5 ppb

Biosafety Evaluation

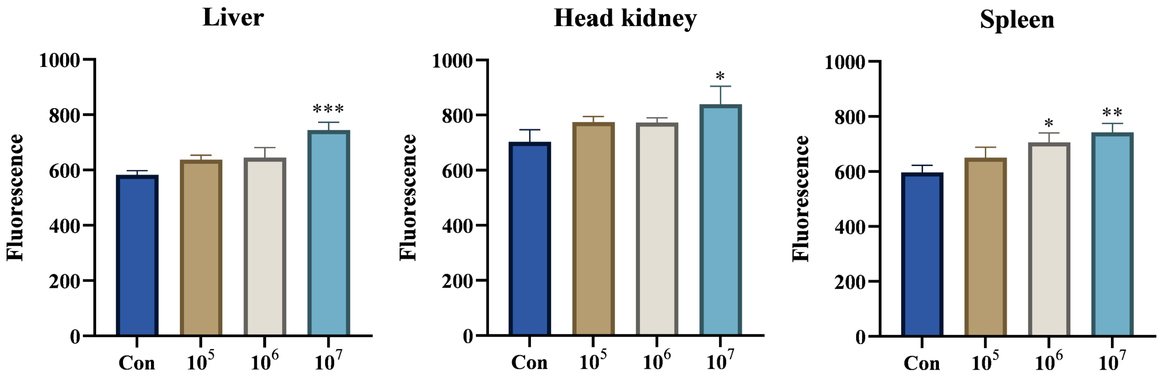
	Control	SP5(10^5)	SP6(10^6)	SP7(10^7)
Initial weight (g)	3.78 ± 0.79	3.98 ± 0.87	3.93 ± 0.83	3.72 ± 0.58
Initial length (cm)	5.02 ± 0.42	5.17 ± 0.41	5.23 ± 0.59	5.01 ± 0.22
Final weight (g)	6.83 ± 3.44	6.89 ± 1.81	7.41 ± 3.38	7.35 ± 2.76
Final length (cm)	6.16 ± 1.02	6.24 ± 0.65	6.38 ± 1	6.44 ± 0.61
Liver (g)	0.2199 ± 0.2029	0.1755 ± 0.0534	0.3145 ± 0.1827	0.2987 ± 0.209
Spleen (g)	0.0117 ± 0.0161	0.0056 ± 0.0029	0.0256 ± 0.0198	0.0092 ± 0.0029
Liver / body ratio (%)	0.0248 ± 0.0145	0.0219 ± 0.0068	0.034 ± 0.0203	0.0312 ± 0.0112
Spleen / body ratio (%)	0.0012 ± 0.0013	0.0007 ± 0.0004	0.003 ± 0.0023	0.0011 ± 0.0006

Intestinal microbiota





Phagocytic activity



Conclusion

A bacterial strain with biodegradation potential was isolated from *Penaeus vannamei* and designated **FC210-1**, showing 99.48% 16S rRNA sequence identity to ***Sphingobium naphthae***. FC210-1 grew at **0 – 30 psu** and **pH 6 – 8**, tolerated certain heavy metals, and had a growth cycle of approximately 96 h. Under both **1 ppm** and **0.5 ppm LMG** conditions, FC210-1 achieved approximately **60% degradation** within two months, demonstrating substantial biodegradation potential. Biosafety tests confirmed that FC210-1 is **non-pathogenic** and compatible with aquatic hosts.